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⑪ Publication number:

0 094 599
B1

⑫

EUROPEAN PATENT SPECIFICATION

⑯ Date of publication of patent specification: **01.04.87**

㉑ Application number: **83104602.4**

㉒ Date of filing: **10.05.83**

㉓ Int. Cl.⁴: **A 61 K 31/195,**
A 61 K 31/215,
C 07 C 103/46,
C 07 C 101/453

㉔ Use of aminophenylacetic acid derivatives for the manufacture of an immunomodulating medical preparation.

㉕ Priority: **11.05.82 JP 78893/82**

㉖ Date of publication of application:
23.11.83 Bulletin 83/47

㉗ Publication of the grant of the patent:
01.04.87 Bulletin 87/14

㉘ Designated Contracting States:
AT BE CH DE FR GB IT LI NL SE

㉙ References cited:
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Description

Background of the Invention

1. Field of the invention

5 This invention relates to the use of a phenylacetic acid derivative as an ingredient for the manufacture of a medical preparation having immunomodulating activity.

2. Prior Art

10 US-A-3 997 669 discloses α -(cyclic tert. aminophenyl)-aliphatic acids having valuable pharmacological properties, antifungal and anti-inflammatory activity. For the manufacture of these final compounds phenylacetic acid derivatives are disclosed without providing information of the pharmaceutical activity of these starting compounds.

15 Dictionary of Organic Compounds, fifth edition, vol. 1, page 306 describes (4-aminophenyl)acetic acid stated to have tuberculostatic activity and being useful as a fibrinolysis inhibitor. Furtheron Chemical Abstracts, vol. 73 (1970) reference No. 64597g discloses 2-(p-aminophenyl)butyric acid said compound being disclosed to have an effect on rat choleresis.

Finally it is known from "Methoden der organischen Chemie (Houben-Weyl)," 4th edition, vol. XI/1, pages 370, 418 and 444 to manufacture aminophenylacetic acid derivatives by the reduction of the corresponding nitro compounds.

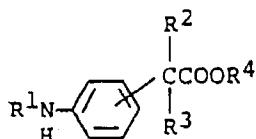
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Summary of the Invention

It has now been found that specific phenylacetic derivatives have an immunomodulating activity and are therefore useful as an ingredient for the manufacture of a medical preparation having immunomodulating activity.

25 Subject matter of the invention therefore is the use of a phenylacetic acid derivative of the formula (I):

30



35

wherein R¹ is hydrogen or



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wherein R⁵ is an alkyl group of 1—6 carbon atoms or an aryl group; R² and R³ are independently hydrogen or an alkyl group of 1—4 carbon atoms; and R⁴ is hydrogen or an alkyl group of 1—6 carbon atoms, or its pharmaceutically acceptable salts as ingredient for the manufacture of a medical preparation having immunomodulating activity.

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The term "immunomodulating activity" used herein is intended to encompass both immunosuppressive activity and immunostimulating activity.

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Brief description of the drawings

Fig. 1 is a graph to show the test results on rats adjuvant arthritis, and the horizontal axis represents the numbers of days after the adjuvant was injected and the perpendicular axis represents the relative swelling volume (%) to that on 9th day.

Detailed Description of Preferred Embodiments

The compounds used according to this invention are represented by the formula (I):

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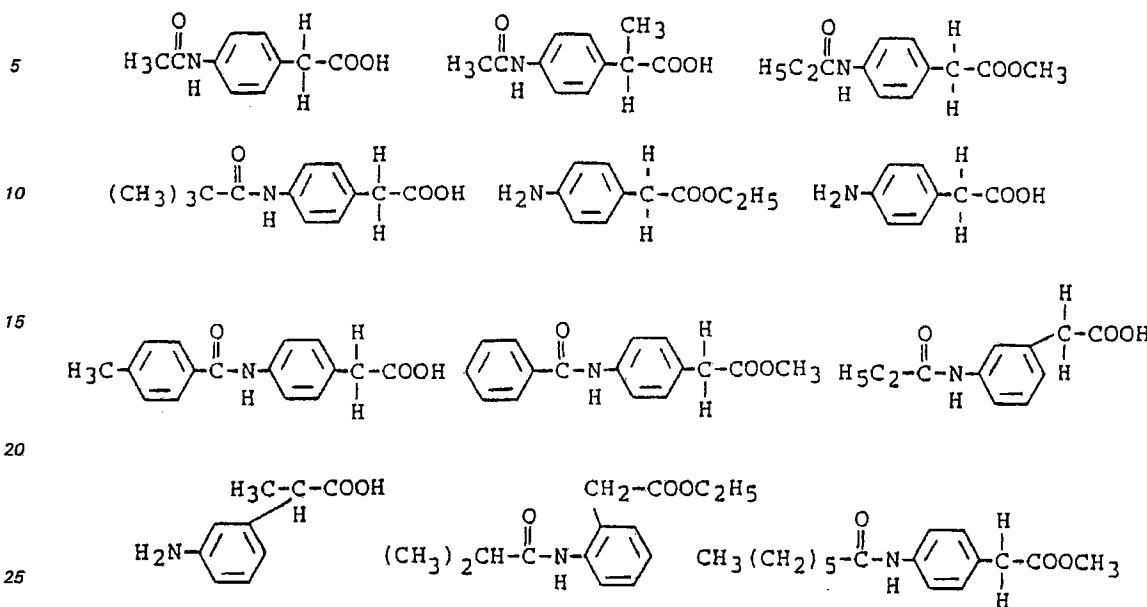


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In Formula (I), the alkyl groups R¹ to R⁵ may be straight or branched; they include methyl, ethyl, n-propyl, isopropyl, n-butyl, isobutyl, tert-butyl and n-pentyl groups. The aryl group R⁵, includes phenyl, tolyl, xylyl and naphthyl groups.

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The examples of the phenylacetic acid derivatives of Formula (I) are:

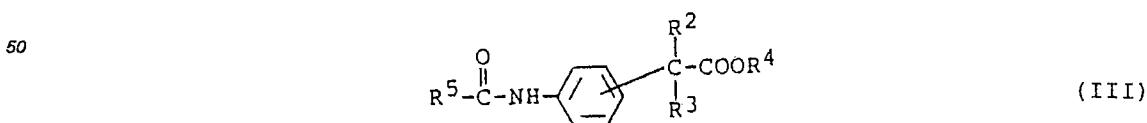
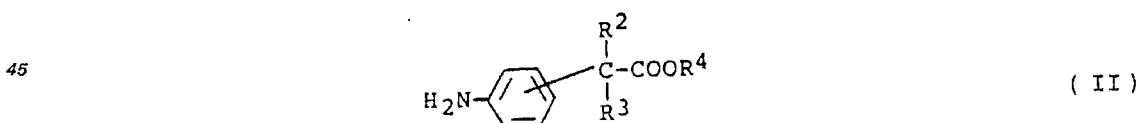


The salts of these phenylacetic acid derivatives of the formula (I) are pharmaceutically acceptable salts which include, in the case where R¹ is



35 and R⁴ is hydrogen, salts with an inorganic base such as an alkali or alkaline earth metal, e.g., sodium, potassium and calcium and salts with an organic base such as procaine, or N,N'-dibenzylethylenediamine; and in the case where R¹ is hydrogen and R⁴ is an alkyl group of 1—4 carbon atoms, acid addition salts such as hydrochloride, sulfate, fumarate, maleate, or formate.

40 The preparation methods of the compounds of the formula (I) used in the present invention are described as follows: The preparation methods are explained by reference to two groups of compounds of formula (II) and formula (III):

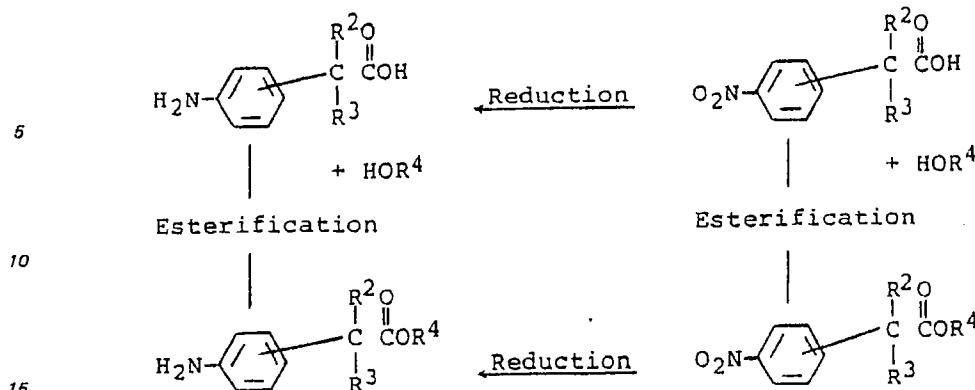


55 wherein R² to R⁵ of Formulas (II) and (III) are as defined in Formula (I).

The aniline derivatives of the foregoing formula (II) can be prepared by various synthetic routes. For reference, examples of such synthetic routes are shown below.

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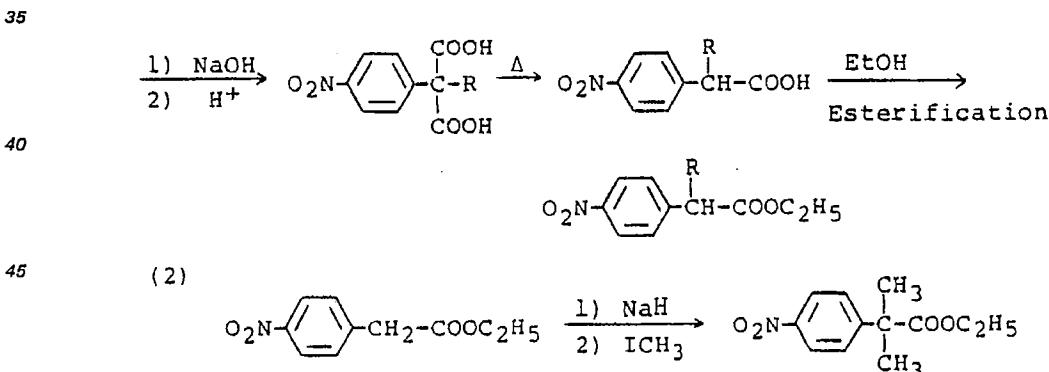
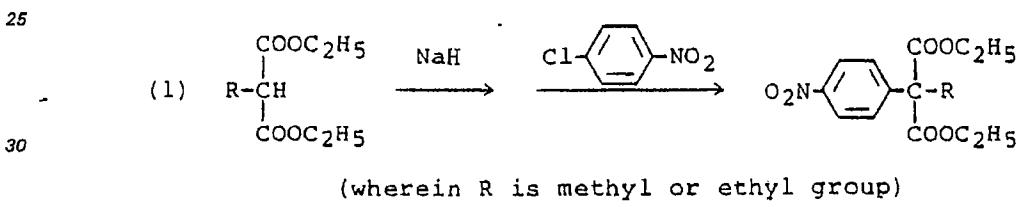
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The reduction may be performed by catalytic hydrogenation using palladium, palladium black or palladium on charcoal. Alternatively, reduction with iron powder/NH₄Cl may be applied.

The esterification may be conducted by heating with the starting alcohol in the presence of hydrochloric, sulfuric or p-toluenesulfonic acid, if necessary, followed by azeotropic dehydration in the presence of an azeotropic dehydrating agent such as benzene, thereby readily providing the desired ester.

Nitrobenzene derivatives used as starting material can be synthesized by various synthetic routes. For reference, examples of such synthetic routes are shown below.



50 A diethyl 2-alkyl-2-(4-nitrophenyl)malonate in the above Process (1) can be obtained by reacting a 2-alkyl malonate with a strong base such as sodium hydride in N,N-dimethylformamide and then with p-halonitrobenzene.

55 Hydrolysis of the resulting ester may be effected by reaction with sodium hydroxide or potassium hydroxide in water or an alcohol (methanol or ethanol) or a mixture thereof.

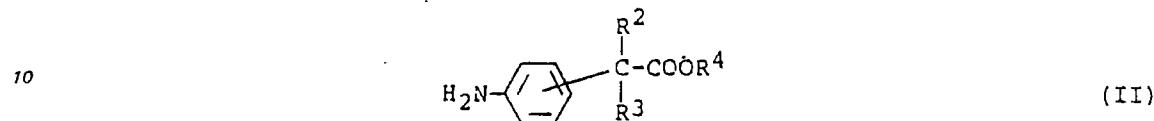
60 An α -alkyl-nitrophenylacetic acid can be obtained by heating a diethyl 2-alkyl-2-(4-nitrophenyl)malonate along with excess sodium hydroxide or potassium hydroxide in water or an alcohol (methanol or ethanol) or a mixture thereof, or by heating a 2-alkyl-2-(4-nitrophenyl)malonic acid along with a suitable acid such as hydrochloric, sulfuric or p-toluenesulfonic acid in a suitable solvent such as an alcohol (methanol or ethanol), benzene, or toluene.

65 The subsequent esterification may be performed by heating with ethanol in the presence of hydrochloric, sulfuric or p-toluenesulfonic acid.

65 Ethyl 2-methyl-2-nitrophenylpropionate in the above Process (2) can be obtained by reacting ethyl nitrophenylacetate with a strong base such as sodium hydride in N,N-dimethylformamide and then with excess methyl iodide.

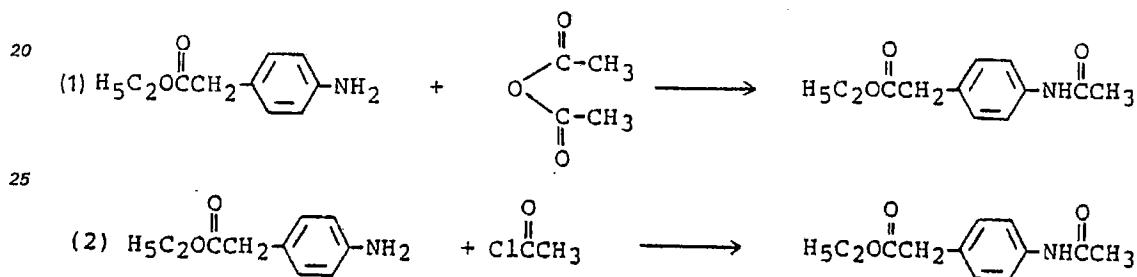
The carboxylic acid of the formula (III), wherein R⁴ is a hydrogen atom, can be easily obtained from the corresponding ester such as methyl and ethyl by a conventional hydrolysis method.

The compound of the formula (III), wherein R⁴ is an alkyl group can be prepared in any conventional manner. For instance, the compound of the foregoing formula (III) can be obtained by reacting an acid anhydride such as acetic anhydride and propionic anhydride with an aniline derivative of the formula (II):



15 And the compound of the above formula (III) can be obtained by reacting a carboxylic chloride with an aniline derivative of the formula (II).

As the methods for preparing ethyl 4-acetylaminophenylacetate, the following two synthetic methods are shown by the reaction schemes:



30 The desired compounds obtained by these processes may be purified by means of recrystallization, ion-exchange treatment, chromatography or activated charcoal treatment according to the conventional practice in organic chemistry.

35 The thus obtained compounds are used as the effective ingredients of the medical preparation having immunomodulating activity useful for the therapy and prevention of various diseases caused from immune reaction.

40 The medical preparation obtained according to the present invention can be administered orally or parenterally (for instance, intramuscularly, subcutaneously, intravenously, rectally) in the form *per se* or in various administration unit forms.

45 As the solid preparations, tablets, sugar coated tablets, film coated tablets, enteric coated tablets, hard or soft gelatin capsules, troches, pills, granules, fine granules and powder may be prepared. As the semi-solid preparations, suppositories, endermics (transdermal system) and ointments may be prepared.

As the liquid preparations, injections, syrups, solutions, inhalants, emulsions or suspensions may be prepared.

50 As the additives of the solid preparations, diluents (for instance, lactose, starches, mannitol, calcium hydrogen phosphate), binder (for instance, cellulose derivatives, polyvinyl alcohol, polyethylene glycol, gelatin, arabic gum, crystal cellulose), disintegrators (for instance, carboxymethylcellulose, crystal cellulose, hydroxypropylcellulose with low substitution degree), lubricant (for instance, magnesium stearate, talc, light silic anhydride, synthetic aluminium silicate), retard-solubilizing agent (for instance, paraffin, coating materials (for instance, polyvinylacetaldieethylaminoacetate, HA (Registered Trade Name), hydroxypropylmethylcellulose and its phthalate, Eudragit (Rohm & Haas), shellac, sucrose, precipitated calcium carbonate, talc, calcium hydrogen phosphate), plasticizer (for instance, castor oil, polyethylene glycol), lustering agent (for instance carnauba wax), are used.

55 As the base of the suppositories, polyethylene glycol, various kinds of vegetable fats and hardened vegetable oils, Witepsol (glycerol fatty acid ester, Dynamite, Nobel AG), are used, and surface active agent may be mixed in these bases.

60 As the base of the ointment, fats and oils base (for instance, fats and oils from animals and plants, waxes, Vaseline®, etc.), water-soluble base (for instance, polyethylene glycol, cetyl alcohol) or emulsion base (for instance, o/w or w/o emulsion base consisting of fats and oils from animals and plants, or mineral oils or synthetic fats and oils and aqueous layer and surface active agents) are used.

65 The liquid preparation can be prepared by dissolving, emulsifying or suspending in distilled water, a lower aliphatic alcohol such as ethyl alcohol, polyalcohols such as polyethylene glycol and polypropylene glycol, dimethylacetamide or fats and oils, or in a mixture thereof. In this case, as solubilizing, emulsifying or suspension agents, various kinds of surface active agents, arabic gum, gelatin, cellulose derivatives may be used depending upon the purpose, and in addition to this, isotonic agents such as sodium chloride,

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preservatives such as p-hydroxybenzoic acid derivative and reversed soap, and furthermore, buffers and local anesthetics may be used.

In order to increase the stability, for instance, it may be good to preserve it as a freeze-dried powder and to dissolve it when using.

5 Any of the solid, semi-solid, liquid preparations as mentioned above may contain colors, perfumes, flavors, sweetenings and stabilizers.

These preparations can be modified to long-acting preparations or micro-capsules in any conventional manner. One or more of the effective ingredients of the present invention may be generally contained at a ratio of 0.1—99%, usually 0.5—90% of the whole composition in the preparation.

10 In the preparations of the present invention, one or more other medicaments, for instance, non-steroidal analgesic, anti-inflammatory agents such as acetylsalicylic acid, indomethacine or phenylbutazone may be used as combination therapy along with the effective ingredients of the present invention.

The oral administration is most common for the administration method, but rectal administration or 15 transdermal administration may be applied, too.

The dose of the effective ingredient is commonly 1—3,000 mg per day for parenteral administration, and 1—3,000 mg per day for oral administration, but the dose may be lower or higher than said dose depend upon the ages, body weight, kinds of diseases or degree of symptoms. In the case of administering a higher dose, it is recommended to administer by dividing the dose into several units.

20 The medical preparation according to the use of the present invention has low toxicity and may be used in therapy, for the following diseases: autoimmune diseases such as chronic rheumatoid arthritis, systemic lupus erythematoses (SLE), collagen disease; allergic diseases such as asthma; cancer; and bacterial infectious diseases.

The present invention will be further illustrated by the following preparations and examples. It should 25 be understood, however, that the examples are given only for the purpose of illustration and not intended to limit the present invention in any way.

Preparation 1

Ethyl p-aminophenylacetate: Compound 1

30 p-Aminophenylacetic acid was refluxed in 15% hydrogen chloride-ethanol. After removal of ethanol by distillation, the residue was extracted with ethyl acetate and the extract was washed successively with water, saturated sodium bicarbonate solution and water and dried. The ethyl acetate was then distilled off to give p-aminophenylacetic acid ethyl ester.

Preparation 2

Ethyl 2-(4-aminophenyl)propionate: Compound 2

After washing 30.3 g of sodium hydride (50% mineral oil suspension) with n-hexane, it was suspended in 370 ml of N,N-dimethylformamide and was stirred under ice cooling. To this was added dropwise 100 g (0.574 mole) of diethylmethyl malonate and the mixture was stirred until the generation of hydrogen was stopped. Subsequently, a solution of 90.5 g (0.574 mole) of p-chloronitrobenzene in 145 ml of N,N-dimethylformamide was added dropwise and the mixture was heated at 80°C on an oil bath for 10 hours. Thereafter, N,N-dimethylformamide was distilled off under reduced pressure and the residue was extracted with ethyl acetate. The ethyl acetate layer was washed with 5% hydrochloric acid and with a saturated solution of sodium chloride, and dried over anhydrous magnesium sulfate. The ethyl acetate was then distilled off under reduced pressure to give 148 g of crude diethyl-2-methyl-2-(4-nitrophenyl)malonate.

40 147 g of the crude diethyl 2-methyl-2-(4-nitrophenyl)malonate was dissolved in 600 ml of ethanol, and to this was added a solution of 42.4 g (0.846 mole) of 93% sodium hydroxide in 400 ml of water and the solution was reacted at 50°C for 3 hours. After that, to the reaction mixture was added 1 l of water and the formed oily substance and an aqueous layer were separated. The aqueous layer was acidified with conc. hydrochloric acid and was extracted with 700 ml of ethyl acetate. The ethyl acetate layer was washed with a saturated solution of sodium chloride and dried over anhydrous magnesium sulfate. After filtering out magnesium sulfate, ethyl acetate was distilled off to give 66.8 g of crude 2-(4-nitrophenyl)propionic acid.

45 23.3 g of the crude 2-(4-nitrophenyl)propionic acid was dissolved in 100 ml of 22% hydrochloric acid-ethanol solution, and the solution was refluxed on an oil bath for two hours. After ethanol was distilled off under reduced pressure, the residue was neutralized with a saturated solution of sodium bicarbonate and extracted with ethyl acetate. The ethyl acetate layer was washed with a saturated solution of sodium chloride and dried over anhydrous sodium sulfate. After distilling off ethyl acetate under reduced pressure, the residue was subjected to silica gel chromatography with chloroform solvent to give 55 g of ethyl 2-(4-nitrophenyl)propionate.

50 60 48.3 g (0.216 mole) of ethyl 2-(4-nitrophenyl)propionate was dissolved in 400 ml of ethanol and the solution was hydrogenated with 1 g of palladium black catalyst for 6 hours. Palladium black catalyst was filtered out and ethanol was distilled off to give 48.3 g of the remained oily substance. The oily substance was distilled under reduced pressure to give 38.6 g of ethyl 2-(4-aminophenyl)propionate as distillation fraction at 124—126°C/1—2 mm Hg (133—266P).

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Preparation 3

Ethyl 2-(4-aminophenyl)-2-methylpropionate: Compound 3

After washing 10.56 g (equivalent to 0.22 mole) of sodium hydride (50% mineral oil suspension) n-hexane, it was suspended in 100 ml of N,N-dimethylformamide and was stirred under ice cooling. A

5 solution of 20.9 g (0.1 mole) of ethyl 4-nitrophenylacetate in 100 ml of N,N-dimethylformamide was added dropwise and the mixture was stirred under ice cooling for 1 hour and at room temperature for 2 hours. After distilling off N,N-dimethylformamide under reduced pressure, extracting with ethyl acetate and washing with 5% hydrochloric acid solution and further washing with a saturated solution of sodium chloride, the ethyl acetate layer was dried over anhydrous sodium sulfate. The ethyl acetate was distilled off under reduced pressure to give 20.33 g (0.086 mol) of ethyl 2-methyl-2-(4-nitrophenyl)propionate (Yield: 86%).

10 20.33 g of thus obtained ester was dissolved in 120 ml of ethanol and hydrogenated with 0.3 g of palladium black catalyst. After the palladium black was filtered out and ethanol was distilled off, the residue was dissolved in 5% hydrochloric acid solution and washed with ethyl acetate. The aqueous layer was

15 neutralized with sodium carbonate and was extracted with ethyl acetate. The ethyl acetate layer was dried over anhydrous sodium sulfate. After distilling off ethyl acetate under reduced pressure, the residue was subjected to a silica gel chromatography with chloroform solvent to give 8.31 g (0.04 mole) of ethyl 2-(4-aminophenyl)-2-methylpropionate (Yield: 47%).

20 Preparation 4

Ethyl 4-acetylaminophenylacetate: Compound 4

To 179.2 g (1 mole) of ethyl p-aminophenylacetate was added 800 ml of ethyl acetate and it was made to a homogeneous solution with stirring at room temperature. To the solution was added a mixed solution of 103.4 ml (1.05 mole) of acetic anhydride (96%) and 100 ml of ethyl acetate and the solution was stirred for 3 hours. After completion of the reaction, the reaction mixture was washed with a saturated solution of sodium bicarbonate and also with a saturated solution of sodium chloride. After drying with the ethyl acetate layer over anhydrous magnesium sulfate, ethyl acetate was distilled off. The residue was

25 recrystallized from ethyl acetate-n-hexane to give 206.6 g of ethyl 4-acetylaminophenylacetate (Yield: 93.4%). M.P. 77—78°C.

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Preparation 5

Ethyl 2-(4-acetylaminophenyl)-2-methylpropionate: Compound 5

5.0 g of ethyl 2-(4-aminophenyl)-2-methylpropionate was dissolved in 50 ml of ethyl acetate, and 2.5 ml of acetic anhydride was added dropwise with stirring and the solution was still slurred in the same condition for 3 hours. The reaction mixture was washed with a saturated solution of sodium bicarbonate, and successively, with a saturated solution of sodium chloride, and the ethyl acetate layer was dried over anhydrous sodium sulfate. The ethyl acetate was distilled off under reduced pressure and the residue was recrystallized from ethyl acetate-n-hexane to give 4.61 g of ethyl 2-(4-acetylaminophenyl)-2-methylpropionate (Yield: 76%). M.P. 76.0—76.5°C.

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Preparation 6

Ethyl 4-(isobutyrylamino)phenylacetate: Compound 6

10 g of ethyl 4-aminophenylacetate was dissolved in 100 ml of benzene and to this was added 25 ml of water. To the solution were added dropwise a solution of 6 g of isobutyryl chloride in 20 ml of benzene and a

45 solution of 2.4 g of 93% NaOH in 25 ml of water simultaneously under stirring over 15 minutes. After completion of the dropwise addition, the reaction mixture was stirred for 3 hours and allowed to stand at room temperature overnight. After separating the benzene layer, washing it with 1N—HCl solution and a further washing with a saturated solution of sodium chloride, the benzene layer was dried over anhydrous sodium sulfate. After separating sodium sulfate by filtration, the solvent was distilled off under reduced pressure and the residue was dissolved in 30 ml of benzene and crystallized from 90 ml of n-hexane. The formed crystals were separated by filtration and were dried at a temperature below 60°C under reduced pressure to give 12.3 g of ethyl 4-(isobutyrylamino)phenylacetate (Yield: 88.3%). M.P. 92.5—93.5°C.

50 Preparation 7

55 Ethyl 4-(n-butyrylamino)phenylacetate: Compound 7

In accordance with Example 6, 10 g of ethyl 4-aminophenylacetate was reacted with 6 g of n-butyryl chloride similarly, and after treating it, 8.5 g of 4-(n-butyrylamino)phenylacetate was obtained. M.P. 72.5—73.5°C.

60 Preparation 8

Ethyl 4-(4-methylbenzoylamino)phenylacetate: Compound 8

10 g of ethyl 4-aminophenylacetate was dissolved in 120 ml of benzene and to this was further added 25 ml of water. To this solution were added dropwise a solution of 8.6 g of p-toluoyl chloride dissolved in 20 ml of benzene and a solution of 2.4 g of 93% NaOH dissolved in 25 ml of water simultaneously under

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stirring over 15 minutes. After completion of the dropwise addition, the solution was stirred for 3 hours and allowed to stand overnight. After adding 200 ml of ethyl acetate, the oil layer was separated, washed with 1N—HCl solution and with a saturated solution of sodium chloride, and dried over anhydrous sodium sulfate. After distilling off the solvent, the residue was recrystallized from benzene—n-hexane to give 12 g of ethyl 4-(4-methylbenzoylamino)phenylacetate.

Preparation 9

Ethyl 2-(4-acetylaminophenyl)propionate: Compound 9

To 10 g (0.0517 mole) of ethyl 2-(4-aminophenyl)propionate was added 50 ml of ethyl acetate with stirring, and to this solution, a mixed solution of 5.81 g of acetic anhydride and 10 ml of ethyl acetate was added dropwise and was stirred for 3 hours. After completion of the reaction, the reaction mixture was washed with a saturated solution of sodium bicarbonate and with a saturated solution of sodium chloride. After the ethyl acetate layer was dried over anhydrous magnesium sulfate, the ethyl acetate was distilled off under reduced pressure. The residue was recrystallized from ethyl acetate—n-hexane to give 10.3 g of ethyl 2-(4-acetylaminophenyl)propionate (Yield: 85%). M.P. 94.5—95.5°C.

Preparation 10

4-Acetylaminophenylacetic acid: Compound 10

To 110.6 g (0.5 mole) of ethyl 4-acetylaminophenylacetate was added 500 ml of water and the mixture was stirred at room temperature. To the solution was added 300 ml of 2N—NaOH and the mixture was stirred for 3 hours.

After completion of the reaction, the reaction system was cooled with ice and the crystals were formed by adding 100 ml of 20% hydrochloric acid solution. After stirring for 30 minutes under ice cooling, the formed crystals were collected by filtration, washed with cold water and dried to give 93.6 g of 4-acetylaminophenylacetic acid (Yield: 96.8%). M.P. 173—175°C.

Preparation 11

2-(4-Acetylaminophenyl)-2-methylpropionic acid: Compound 11

3.87 g of ethyl 2-(4-acetylaminophenyl)-2-methylpropionate was dissolved in a mixed solution of 16.6 ml of 2N-caustic soda solution and 30 ml of ethyl alcohol and the solution was stirred at 50°C for 8 hours. After distilling off ethyl alcohol under reduced pressure, the aqueous layer was extracted with ether and unreacted materials were removed. After the aqueous layer was acidified with conc. hydrochloric acid, the formed crystals were collected by filtration, washed with water, and recrystallized from acetone-water to give 2.15 g of 2-(4-acetylaminophenyl)-2-methylpropionic acid (Yield: 62%). M.P. 169.7—170.8°C.

Preparation 12

In accordance with Example 10, the following carboxylic acids were obtained by hydrolyzing an ethyl carbonate corresponding to the carboxylic acid:

40	2-(4-Acetylaminophenyl)propionic acid:	Compound 12
	4-Isobutyrylaminophenylacetic acid:	Compound 13
	4-n-Butyrylaminophenylacetic acid:	Compound 14
	4-(4-Methylbenzoylamino)phenylacetic acid:	Compound 15

Example 1

Effect on Plaque-forming Cells in Spleen against Sheep Erythrocytes in mice

Balb/c mice of 5 weeks old were intravenously immunized with 1×10^8 sheep erythrocytes/mouse. 5 mice were used per group. Medicament was orally administered for 4 days from the day when the mice were immunized. Mice were sacrificed on the 5th day and the numbers of plaque-forming cells (PFC) in the spleen against sheep erythrocytes were determined by Fujiwara's modified method of Cunningham's method ["Method in Immunological Experiment A" edited by Japanese Society for Immunology, page 1272 (1974)].

The results are as shown in Tables 2 and 3.

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TABLE 2

5	Medicaments	Dose (mg/kg)	PFC ($\times 2,500/\text{spleen}$) Mean value \pm Standard Error	% Control
10	Physiological saline solution	—	64.2 \pm 5.66	—
15	Compound 10	30	116.4 \pm 8.64**	181
15	Compound 10	100	107.2 \pm 10.5 **	167
15	Compound 10	300	82.2 \pm 7.0	128

** P < 0.01

TABLE 3

20	Medicaments	Dose (mg/kg)	PFC ($\times 3,125/\text{spleen}$) Mean value \pm Standard Error	% Control
25	Physiological saline solution	—	66.4 \pm 3.6	—
30	Compound 1	30	89.4 \pm 10.4	135
30	Compound 1	100	60.6 \pm 8.6	91
35	Compound 1	300	82.0 \pm 5.2*	123

* P < 0.05

Example 2

Effect on Sheep Erythrocytes induced Delayed Type Hypersensitivity

40 $40 \mu\text{l}$ of Sheep erythrocytes adjusted to the concentration of $1 \times 10^7/40 \mu\text{l}$ was subcutaneously injected to the right footpad of mice (ddY weighing 25–30 g) and the medicament was administered orally for continuous 4 days including the day, on which sheep erythrocytes were administered.

45 On the 4th day from the administration day of sheep erythrocytes, $40 \mu\text{l}$ of sheep erythrocytes adjusted to the concentration of $5 \times 10^8/40 \mu\text{l}$ was subcutaneously injected to the left footpad. After 24 hours, both of the thickness of the right and left footpad were measured. Footpad swelling due to the delayed type hypersensitivity was recognized as the difference between the thickness of the left and right footpad. The footpad swelling of the medicament-administration group was compared to that of physiological saline solution-administration group (control group). The results are shown in Table 4.

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TABLE 4

	Medicaments	Dose (mg/kg)	% Control of footpad swelling
5	Physiological saline solution	—	—
10	Azathioprine	100	49.0**
	Compound 10	30	77.0*
		100	85.7
15		300	71.6**
	Compound 16	30	78.5**
20		100	81.4
		300	90.8
	Compound 1	30	79.8*
25		100	85.9
		300	77.9*
30	Compound 4	30	91.5
		100	93.8
		300	68.4*

35 * P < 0.05 ** P < 0.01

Example 3

40 Effect on Methylated Human Albumin induced Delayed Type Hypersensitivity

100 μ l of 0.25% methylated human albumin aqueous solution was injected subcutaneously to C3H mice of 5 weeks old. The medicament was administered orally for continuous 4 days including the immunization-day. On the 4th day from the immunization day, 25 μ l of 0.1% methylated human albumin aqueous solution was subcutaneously injected to the footpad. After 24 hours, the thickness of the left and right footpad were measured, and the footpad swelling due to the delayed type hypersensitivity was represented as the difference between the thickness of the left and right footpad. The footpad swelling of the medicament-administration group was compared with that of physiological saline solution-administration group.

45 The results are shown in Table 5.

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TABLE 5

Medicaments	Dose (mg/kg)	Footpad swelling ($\times 0.01$ mm) Mean value \pm Standard error	% Control
EXPERIMENT 1			
Physiological saline solution	—	63.3 \pm 1.6	—
Compound 10	300	44.5 \pm 1.6**	70.3
Compound 6	30	59.0 \pm 1.8	93.2
	100	55.6 \pm 1.2**	87.8
	300	56.8 \pm 2.2*	89.7
Compound 13	30	57.2 \pm 1.9*	90.4
	100	58.2 \pm 1.9	91.9
	300	58.5 \pm 2.4	92.4
Compound 15	30	54.2 \pm 1.7**	85.6
	100	56.7 \pm 1.8**	89.6
	300	57.4 \pm 1.5*	90.7
EXPERIMENT 2			
Physiological saline solution	—	58.4 \pm 1.6	—
Azathioprine	100	41.4 \pm 1.5**	70.9
Compound 10	30	46.1 \pm 1.7**	78.9
	100	41.8 \pm 2.5**	71.6
	300	42.3 \pm 1.8**	72.4
Compound 12	30	54.5 \pm 1.7	93.2
	100	52.1 \pm 1.5*	89.2
	300	52.4 \pm 1.9*	89.7
Compound 9	30	51.4 \pm 1.8**	88.0
	100	55.3 \pm 2.0	94.7
	300	56.0 \pm 2.0	95.9
Compound 12	30	54.5 \pm 1.7	93.3
	100	55.4 \pm 1.8	94.9
	300	51.3 \pm 2.3*	87.8

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TABLE 5 — continued

	Medicaments	Dose (mg/kg)	Footpad swelling (x 0.01 mm) Mean value ± Standard error	% Control
10	Compound 14	30	50.9 ± 2.0**	87.2
		100	51.8 ± 1.4**	88.7
		300	56.7 ± 1.5	97.1
EXPERIMENT 3				
20	Physiological saline solution	—	64.0 ± 1.7	—
	Compound 16	30	57.2 ± 2.8*	89.4
		100	62.6 ± 3.1	97.8
25		300	50.7 ± 2.3**	79.2
	Compound 4	30	48.3 ± 2.6**	75.5
		100	49.4 ± 3.5**	77.2
30		300	56.5 ± 2.9*	88.3

* P < 0.05 ** P < 0.01

Example 4

Effect on Rats Adjuvant Arthritis

Experiment method

10 Sprague Dawley male rats of 8 weeks old were used per one group, and 0.6 mg/0.05 ml of mycobacterium butyricum suspended in a fluid paraffin was administered to the right posterior limb palm intradermally.

1 mg/kg—125 mg/kg of Compound 10 was administered orally from the previous day of the adjuvant injection for 27 days, and the volume of the palm was measured.

45 *Results*

From around the 10th day after adjuvant injection, so called, the secondary inflammation appeared. This appeared as swelling of limb, to which an adjuvant was injected and also as swelling of the limb, to which an adjuvant was not injected, and as nodes of auricle, tail and limbs.

Compound 10 showed the inhibitory activity especially at a low dose to these secondary inflammation.

50 Since the inhibitory activity of Compound 10 was very slight to the primary inflammation due to the direct action of the adjuvant, the changes of the relative swelling of the limb (%) to that on the 9th day are shown in Fig. 1.

The horizontal axis represents the number of days elapsed after the adjuvant was injected and the perpendicular axis represents the relative swelling (%) to that on the 9th day.

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Example 5

Acute Toxicity

The medicament was suspended in 3% "Tween-80" and the suspension was administered orally or intraperitoneally at a dose shown in Table 1 to mice (ddY weighing 20—25 g). The mortalities of mice treated with medicament on the 7th day after the administration are shown in Table 1

TABLE 1

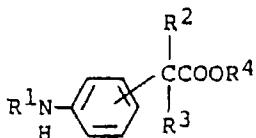
	Medicaments	Dose (mg/kg)	Administration routes	Numbers of dead mice/ Numbers of mice used
5	Compound 6	5,000	oral	1/5
		1,000	intraperitoneal	0/5
10	Compound 13	5,000	oral	0/5
		1,000	intraperitoneal	1/5
15	Compound 15	5,000	oral	5/5
		1,000	oral	0/5
		1,000	intraperitoneal	5/5
20	Compound 12	300	intraperitoneal	0/5
		5,000	oral	0/5
		1,000	intraperitoneal	0/5
25	Compound 9	1,500	oral	0/5
		1,000	intraperitoneal	0/5
30	Compound 11	5,000	oral	0/5
		1,000	intraperitoneal	0/5
35	Compound 14	1,000	intraperitoneal	0/5
		5,000	oral	0/5
40	Compound 10	1,000	intraperitoneal	0/5
		3,000	oral	0/5
45	Compound 1	1,000	intraperitoneal	1/5

Claim

The use of a phenylacetic acid derivative of the formula (I):

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wherein R¹ is hydrogen or

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wherein R⁵ is an alkyl group of 1-6 carbon atoms or an aryl group; R² and R³ are independently hydrogen or an alkyl group of 1-4 carbon atoms; and R⁴ is hydrogen or an alkyl group of 1-6 carbon atoms, or its pharmaceutically acceptable salts as ingredient for the manufacture of a medical preparation having immunomodulating activity.

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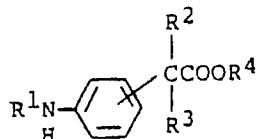
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Patentanspruch

Verwendung eines Phenylsuccinates der Formel (I)

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in der R¹ ein Wasserstoffatom oder eine Gruppe der Formel

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20 bedeutet, worin R⁵ eine Alkylgruppe mit 1 bis 6 Kohlenstoffatomen oder eine Arylgruppe darstellt; R² und R³ unabhängig voneinander Wasserstoffatome oder Alkylgruppen mit 1 bis 4 Kohlenstoffatomen bedeuten und R⁴ ein Wasserstoffatom oder eine Alkylgruppe mit 1 bis 6 Kohlenstoffatomen bedeutet, oder seiner pharmazeutisch annehmbaren Salze als Bestandteil für die Herstellung eines medizinischen Präparats mit immunregulierender Wirkung.

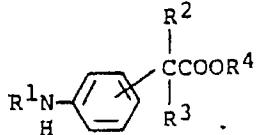
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Revendication

Utilisation d'un dérivé d'acide phénylacétique de formule (I):

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dans laquelle R¹ est un atome d'hydrogène ou un groupe

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45 où R⁵ est un groupe alcoyle contenant 1 à 6 atomes de carbone ou un groupe aryle; R² et R³ sont indépendamment un atome d'hydrogène ou un groupe alcoyle contenant 1 à 4 atomes de carbone; et R⁴ est un atome d'hydrogène ou un groupe alcoyle contenant 1 à 6 atomes de carbone, ou des sels de celui-ci acceptables du point de vue pharmaceutique comme composants pour la fabrication d'une préparation médicale ayant une activité d'immunomodulation.

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Fig. 1

